EPIC INSTRUMENTS INCORPORATED

WaveDisplay

WaveDisplay

(ver 1.00)

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WaveDisplay (ver:1.00)

OPERATION MANUAL

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****** LICENSE AGREEMENT ******

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LICENSE

You may:

(1) use the program only on a single machine.

(2) copy the program only for backup purposes in support of your use of the program on the single machine.

LIMITED WARRANTY

The program is provided "AS IS" without warranty of any kind, either expressed or implied. The entire risk as to the performance of the program is with you. Should the program prove defective, you assume the entire cost of all necessary servicing, repair or correction.

Epic Instruments Inc. does warrant the diskette on which the program is furnished, to be free from defects in materials and workmanship for a period of (90) days from the date of delivery to you.

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INTRODUCTION:

The purpose of the WaveDisplay software package is to allow the IBM PC to be converted into a very intelligent oscilloscope. With the WaveDisplay, functions such as unlimited waveform displays, precise voltage/width measurements, selective expansions, and waveform averaging etc. is all possible; but probably the most advantageous feature is being able to store the captured waveform in its original form on disk for analysis at a later date.

The WaveDisplay will accept any serially sent numeric codes and convert the received data into an X/Y type line graph to be displayed on the CRT monitor. Functionally the data is sent by the data acquisition device to the IBM via the RS-232 port. After the transfer is completed, the acquired data is then loaded onto one of the disk drives as a data file. The file can now be displayed or retained for later analysis. Before displaying the stored data files, the system or display parameters should be set, this is equivalent to dialing in the voltage attenuation and setting the Time per Division on an oscilloscope; this setup information can be bypassed if displaying the waveform is all that is required.

The placement of the waveform on the CRT is user selectible and the waveform can be placed anywhere and compressed (vertically) to any size that is required. Multiple data files can be displayed at the same time, this feature allows for multiple comparisons between captured data. Specific portions of the waveform can also be expanded and displayed; if an "average" of a particular data file is required, that too can be displayed together with any other displayed data. A "grid" resembling the one on an oscilloscope can be superimposed onto the display area of the CRT if required and removed (without destroying the displayed waveforms) after the measurement.

The user should note that due to the limited display resolution of the IBM Color/Graphics card of only 640 horizontal and 200 vertical points; the full 8 bits vertical resolution of the Wavesavers cannot be displayed. The actual waveform (vertical) shown on the CRT display is actually compressed or "averaged" to fit the 640 x 200 display area. Also, the horizontal (record length) width of the Wavesavers is much wider than the 640 horizontal points that the IBM card provides, this necessitated the need to also compress the horizontal width, the amount of compression is therefore determined by the "original size" of the data length. But by using the expand feature of the WaveDisplay every horizontal sampled points can be viewed if required.

HARDWARE REQUIREMENTS:

The WaveDisplay Software package is written to operate on the IBM Personal Computer or any IBM compatible type (IBM clones) computer. Most of WaveDisplay is written in Basic with some assembly routines inserted within the Basic program. We have to the best of our ability avoided using any routines which is unique only to the IBM PC.

The WaveDisplay runs under the MS/DOS or PC/DOS operating system, either versions 1.1 or 2.0 can be used. The computer should be equipped with 128K of RAM and at least one disk drive (either single or double sided, IBM format). An RS-232 interface card is also required; the IBM Color Graphics card and a suitable CRT monitor is needed to display the data; WaveDisplay will not work with the IBM monochrome display card. Users equipped with some of the IBM compatible graphics cards on the market should have no problems with the WaveDisplay.

The screen dump codes supports either the IBM or the Epson printers equipped with the graphics ROM. We also have versions which would work on some of the other more popular dot-matrix printers on the market, please contact Epic Instruments for more information.

Please fill in the registration card and return it to us as soon as possible, as this will not only validate your software license agreement but also keep you up to date on any revisions made to WaveDisplay (ver: 1.00).

INSTALLATION PROCEDURE:

NOTE: Please read the following before using the distribution diskette that came with your WaveDisplay package.

The following paragraphs assumes the user of the WaveDisplay package is familiar with the operation of the IBM PC. If you have not operated the IBM PC before, please refer to the IBM "GUIDE TO OPERATIONS" before attempting to operate the WaveDisplay.

The WaveDisplay distribution diskette comes supplied on a single sided, double density diskette (160K, Dos 1.1 format) and does not contain the operating system. Therefore the very first thing you should do is to copy all the files from the WaveDisplay distribution diskette onto a newly formatted diskette equipped with a "system". Then store the distribution diskette away in a safe place.

The entire WaveDisplay program is on the file named WAVE.EXE ; besides WAVE.EXE, you will also find files MONO.COM, COLOR.COM, DATA.001, DATA.002 and DATA.003. As noted, WAVE.EXE contains the WaveDisplay program, COLOR.COM and MONO.COM is used to toggle between users with both the IBM Monochrome card and the Color graphics card installed; DATA.001, DATA.002 and DATA.003 are examples that we will use to demonstrate the operation of WaveDisplay.

Users with PC's that are loaded with RAM memory can take advantage by the increase in operating speed gained by assigning a portion of the memory to simulate a disk drive. The software routine for this type of operation is usually provided by the manufacturer of the memory expansion board. The minimum size of the "Ram Drive" should be at least 128K.

Later on, you might also want to create an AUTOEXEC.BAT file to boot right into WAVE.EXE after the PC is turned on.

********** NOTE ***********

TO ABORT THE PROGRAM AND RETURN TO THE OPERATING SYSTEM, TYPE **"QUIT and (cr)"** AT THE COMMAND LINE.

(cr) = carriage return

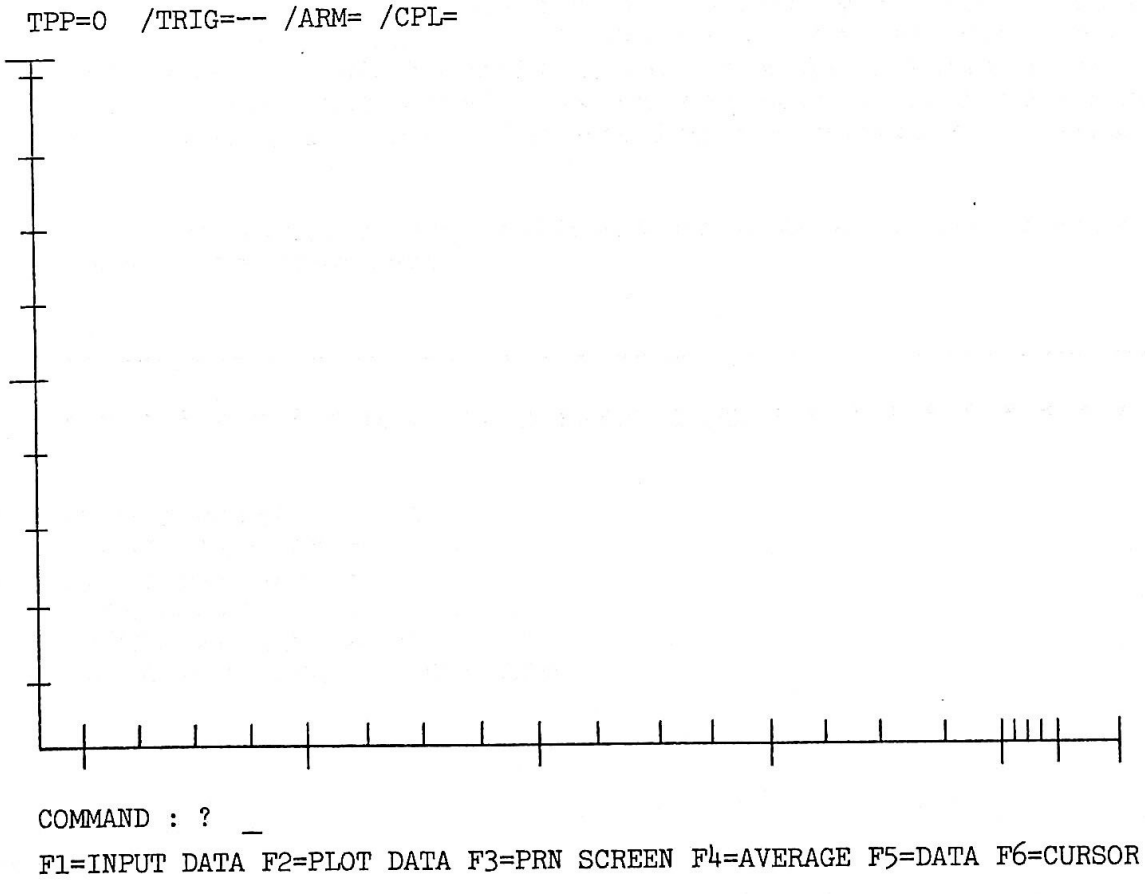
USING WAVEDISPLAY:

THE "CAPS LOCK" KEY SHOULD BE SET FOR UPPER CASE FOR ALL OPERATIONS

Insert the working copy of the WaveDisplay into the "A:" drive, now apply power to the computer; when the A> is visible type:"WAVE", and hit the RETURN key; after some disk action, the copyright notice will become visible, hit RETURN again, (this will bring you into the main display) the display below should now become visible.

******** NOTE ********

If you have both the monochrome card and the graphics card on the same system, use COLOR.COM to switch over to the graphics screen before running WAVE.EXE.



The WaveDisplay consists mainly of six functions, they are F1=INPUT DATA, F2=PLOT DATA, F3=PRN SCREEN, F4=AVERAGE, F5=DATA, F6=CURSOR, and if you refer to your CRT, you can see them on the bottom of the screen.

These functions can all be accessed using the function keys F1 thru F6. Each function key when selected, displays its own messages and prompts the user in the use of that particular mode. For demonstration purposes we shall plot a waveform on the display area and show the various display options available.

First we will select the F5 function key, this will enable us to enter the display parameters for the following example.

Hit the F5 function key, The message following the Command line should read :-

DATA NOTE: This will erase the screen / Hit 'A' to abort ? _

This message means that if you hit the F5 key by mistake, you can use the 'A' key followed by a RETURN to delete the function. If you simply hit RETURN, F5 will enable the data setup routine, also anything that was previously on the screen will be erased. This function (F5) is useful for erasing the entire grid area of the CRT.

Depress the F5 function key followed by a RETURN. The following screen should be displayed.

```
------------------------------------------------------------

  * * * * * * * * * * WAVESAVER SETUP DATA * * * * * * * * * *


[1] TIME PER POINT    =  0
[2] PRE/POST TRIGGER =
[3] INT/EXT TRIGGER   =
[4] +/- TRIGGER       =
[5] AUTO/MANUAL ARM   =
[6] INPUT AC/DC CUPL =    COUPLED

[7] ENTER  7  TO RETURN TO MAIN DISPLAY <----------


ENTER LINE NUMBER :-

------------------------------------------------------------
```

The setup data can be entered in any sequence, simply select the line number and enter the value desired; but for this demo, enter the following settings.

*** * * NOTE: (cr) is carriage return. * * ***

ENTER LINE NUMBER :- **1**
TIME PER POINT:- ? **5** (cr)

ENTER 'M' FOR milliseconds OR 'U' FOR microseconds:- ? **U** (cr)

ENTER LINE NUMBER :- **2**
ENTER 'PR' FOR PRETRIGGER OR 'PO' FOR POST-TRIGGER:- ? **PO** (cr)

ENTER LINE NUMBER :- **3**
ENTER'I'FOR INTERNAL TRIGGER OR'E'FOR EXTERNAL TRIGGER:- ? **I** (cr)

ENTER LINE NUMBER :- **4**
ENTER 'P' FOR POSITIVE OR 'N' FOR NEGATIVE TRIGGER:- ? **P** (cr)

ENTER LINE NUMBER :- **5**
ENTER 'A' FOR AUTO OR 'M' FOR MANUAL ARMING:- ? **A** (cr)

ENTER LINE NUMBER :- **6**
ENTER 'A' FOR AC COUPLED OR 'D' FOR DC COUPLED:- ? **D** (cr)

ENTER LINE NUMBER :- **7**
This enables the return to the main display.

NOTE: The information entered in function F5 is abbreviated on the top line of the main display.

[F2] PLOT DATA:

Now select the F2=PLOT DATA mode, this will bring up the command line to plot the selected file on the CRT monitor.

COMMAND : ? PLOT DATA --> NAME OF FILE TO PLOT :- ?
answer by typing: **DATA.001** (cr)

COMMAND : ? PLOT DATA --> FULL MEMORY WIDTH 0.5,1,2 or 4 [K] :- ?
answer by typing: **2** (cr)

COMMAND : ? PLOT DATA --> TOP LOCATION :- ?
answer by typing: **0** (cr)

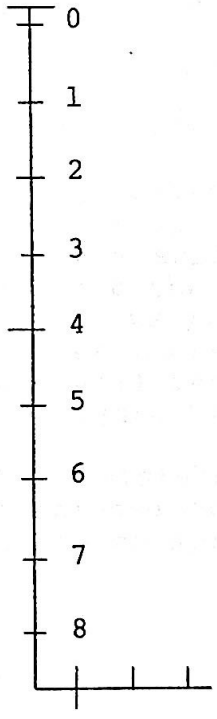
COMMAND : ? PLOT DATA --> BOTTOM LOCATION :- ?
answer by typing: **8** (cr)

COMMAND : ? PLOT DATA -->FULL SCALE RECORD LEVEL (+/-volts) :- ?
answer by typing: 2 (cr)

COMMAND : ? PLOT DATA --> [C] TO CLEAR LOCATION OR [P] TO PLOT:-?
answer by typing: P (cr)

The waveform (DATA.001) should now be plotting on the CRT screen. Wait until the "COMMAND" line is cleared, as this signals that the plotting is complete for file DATA.001.

We have just demonstrated the plotting of a stored waveform onto the CRT; the sequence of initiating a plot will always be similar to the above example. All the examples files provided are 2K in width. Try selecting different "plot" widths (PLOT DATA --> FULL MEMORY WIDTH function) when plotting and note the effect. The vertical display grid is divided exactly into 8 divisions like most oscilloscopes; they are labeled (not visible on CRT) from 0 to 8, the top marker is "0" and the bottom marker is "8".



You can actually plot the waveform within any vertical division(s) by selecting the "TOP" plot point and "BOTTOM" plot point during the F2 function initialization. Usually the "TOP" point is of a lesser value than the "BOTTOM" point, eg. TOP=1 BOTTOM=4, but if you wish to invert the waveform; simply reverse the waveform placement markers, eg. TOP=4 & BOTTOM=1.

NOTE: On the last entry of the F2 function :-
[C] TO CLEAR LOCATION OR [P] TO PLOT:-
The [P] function simply plots the data on the specified location (overlay).
The [C] function will actually clear or erase the portion where the new data is to be plotted.
To clear the entire display, select function F5, and get into the data entry menu. Now select line 7, this will bring back the "display" screen. Try displaying the sample waveforms provided onto the CRT screen in different vertical "slots" and note the results.

********** NOTE **********

Please be aware that the program can be "bombed" if the file name entered to be displayed does not exist or is located on the wrong disk drive. If this occurs the computer will give a "File not found in line 1820" error message, and return you to the operating system. So make sure that the file name entered does exist on the drive specified.

[F3] PRN SCREEN: (Print Screen)

Function F3 outputs the entire display on the CRT monitor to a dot matrix printer.

NOTE: The standard distribution copy of the WaveDisplay only supports the C.Itoh Prowriter series of printers and the NEC dot matrix printers. If you have a different type of printer capable of graphics, please contact Epic Instruments Inc. for more information.

Use the following sequence to dump screen:-

Press the **F3** key.

The following will immediately be displayed on the command line:-

PRINT SCREEN : RETURN TO ABORT OR [P+RETURN] TO PRINT : ? _

If you decide to return to the other functions and not do a screen dump, simply hit the return key. If you decide to continue with the function, make sure the printer is 'ON' and operational, then hit the "P" key followed by a return. Just before the printer starts printing, the command line and the function keys line will be blanked. When the screen dump is completed; the command line will return to the command level and the function keys line will again be visible.

If by mistake, the [P+RETURN] was executed but the printer malfunctioned or was not turned 'ON'; simply wait about 15 seconds and WaveDisplay will return you to the command level.

[F4] AVERAGE:

The averaging function simply takes the number of points specified, adds them together and does a division (divided by the specified number of points), then plots the averaged value on the CRT.

** USE THE F5 FUNCTION TO CLEAR THE DISPLAY BEFORE CONTINUING. **

To access this function, hit the F4 function key:-
The following will be immediately displayed on the command line:-

AVERAGE NUMBER OF POINTS TO BE AVERAGED :- ? _
Answer by typing: **20** (cr)

AVERAGE --> NAME OF FILE TO PLOT :- ? _
Answer by typing: **DATA.001** (cr)

AVERAGE --> FULL MEMORY WIDTH 0.5,1,2 or 4 [K] :- ? _
Answer by typing: **2** (cr)

AVERAGE --> TOP LOCATION :- ? _
Answer by typing: **0** (cr)

AVERAGE --> BOTTOM LOCATION :- ? _
Answer by typing: **4** (cr)

AVERAGE --> FULL SCALE RECORD LEVEL (+/-volts) :- ? _
Answer by typing: **2** (cr)

AVERAGE --> [C] TO CLEAR LOCATION OR [P] TO PLOT :- ? _
Answer by typing: **P** (cr)

Wait for the waveform to be plotted; then use the F2 key and plot DATA.001(in its original form) between location 4 and 8. The difference will be quite apparent.

The maximum number of points that can be averaged is 99. Any amount of waveforms can be averaged and displayed on the screen for comparison purposes. You can also do an overlay(S) over the original waveform; This is easily accomplished by plotting the averaged waveform using the same waveform placement locations as the original.

[F6] CURSOR:

The CURSOR function is probably the heart of the WaveDisplay program. This function will enable you to expand specific parts of the waveform, measure voltages & time , and do various other functions related to waveform analysis.

Before we demonstrate the use of function F6, please clear the screen and plot DATA.001 between coordinates 0 and 4, the "FULL SCALE VOLTAGE LEVEL" should be set at 2 volts.

Access the F6 function, the following lines should now be displayed:-

PRESS [V] FOR VOLTAGE = / [G] FOR GRID :-
MARKER = / CURSOR = / WIDTH = / EXPAND = X
COMMAND : ? CURSOR

We will now explain each of the above functions that F6 offers before proceeding to demonstrate F6.

PRESS [V] FOR VOLTAGE =
If you press the **V** key, WaveDisplay will actually reach into the data file, read the data point requested and then display the reading after the " = " sign; eg: PRESS [V] FOR VOLTAGE = **1.08.**

/ [G] FOR GRID :-
Pressing the **G** key will plot a grid over the display area. To remove the grid, use the lower case **'g'** (shift + G) to remove the grid when not required.

MARKER =
Displays the beginning position that is "marked" for expansion or for time measurements.

CURSOR =
Displays the position of the cursor.

/ WIDTH =
Displays the "difference" between the marker position and the position of the cursor; this in effect gives the "time" or "width" between the marker and the cursor position.

/ EXPAND = X
Displays the amount of expansion possible between the marker and cursor. The maximum expand width is x30. When the WaveDisplay expands the portion marked by the marker and cursor it always covers the exact width of the display area, no more and no less;

the greater the width between the marker and the cursor is, the lesser the expansion. The closer the marker and the cursor is, the greater the expansion.

[F6] CURSOR: (Demonstration)

The **">"** key moves the cursor to the right and the **"<"** key moves the cursor left. each depression of the > or < key generates one step. By simply using "(shift) > or <", the speed of the cursor movement is greatly improved.

1/ Move the cursor right until the **CURSOR = 256.**

2/ Hit the **"M"** key, this marks the position 256.
(Note that the cursor will disappear, but if you move the cursor over one position, the cursor will reappear; the disappearance is due to the overlaping of the two lines. It is possible to erase the marker line and still mark the position desired; simply hit the "M" key twice when marking the position. You can even place multiple markers anywhere along the horizontal axis and remove markers by placing the cursor over the unwanted marker and hitting the "M" key. Note that the last marked marker is the one that will be displayed on the **MARKER** = position.)

3/ With the marker at 256, move the cursor to position 1024. The **/ WIDTH =** should show the value "768.000", this is the width between the markers. If the TIME-PER-POINT = 1u (micro-seconds), the width between the marker and the cursor is therefore (768 x 1u) = 768 usec.

4/ Hit the "E" key, this calls out the expansion function. The command line will show:-

CURSOR --> TOP LOCATION :- ? _
Enter the top position where you would like to place the top part of the expanded waveform.

CURSOR --> BOTTOM LOCATION :- ? _
Enter the bottom position for the expanded waveform.

CURSOR --> FULL SCALE RECORD LEVEL (+/-volts) :- ? _
Enter: **2 (cr)**

CURSOR --> [C] TO CLEAR LOCATION OR [P] TO PLOT :- ? _
Enter: **P (cr)**

The expanded waveform should now be plotting.

[F1] INPUT DATA:

We have left the first function last because it contains the most variables and which problems can easily arise if the basic "operating rules" are not adhered to.

Like most computer systems, the interfacing to peripherals is probably the most "tricky" of all functions. The WaveDisplay is primarily written for our Wavesavers Recorders, but interfacing to other data acquisition systems should present no problems.

NOTE: WaveDisplay uses the "COM1:" port of the IBM PC.
9600 Baud.
No parity bit.
8 bit data.
1 stop bit.

In BASIC it would be = OPEN "COM1:9600,N,8,1" AS #1

The WaveDisplay uses the RS232 port of the IBM PC for data input. The format is quite simple; due to the long lengths of most data stream, the maximum baud rate of 9600 is used for the data transmission rate. The data should be in octal form, with the MSB (most significant bit) sent first followed by the other bits, after the last bit is transmitted, a carriage return must be sent. This carriage return tells the IBM that the data sent was one "reading" or "point". The IBM will then respond by sending a numeral "0" to request another reading, the cycle will continue until the full length of the specified data has been transmitted; when this occurs, a character "X" will be sent (by the IBM) telling the transmitting source to terminate the transmission.

IN SUMMARY:-

NOTE: 8 bit data assumed.

1/ IBM request data, sends character "0".
2/ Acquisition system sends MSB.
3/ ---------- ------ ----- next bit.
4/ ---------- ------ ----- LSB.
5/ ---------- ------ ----- carriage return.
6/ Repeats steps 1 thru 6 until a
character "X" (end) is sent by IBM.
7/ File will be created on diskette under file name specified.
8/ Return to command level.

[F1] Command Sequence:-

1/ Select the F1 function.

2/ The Command Line will show:

[F1] ENTER NAME OF FILE :- ? __
Respond by entering the name desired, followed by (cr).

[F1] LENGTH OF FILE (0.5K, 1K, 2K or 4K) :- ? __
Enter the length of the data stream. If data is shorter then the four choices shown, simply enter the closest value.

ENABLE DATA SOURCE AND HIT RETURN WHEN READY :- ? __
Make sure the data source is ready for transmitting when requested. Then hit (cr).

PLEASE WAIT.....
Data is being transmitted, wait for next message.

DATA ENTERED.....NOW TRANSFERRING TO DISC
A file under the name specified is being created.

DATA TRANSFERRED TO DISC, RETURN TO CONTINUE :- ? __
The data has been transferred to the diskette, enter a (cr) to return to the command level.

The data transmitted is now on a diskette file ready for display and analyzing.

******* USERS OF WAVESAVERS: *******

The sequence of operating the Wavesavers and the companion M232 (parallel to serial converter) with the WaveDisplay is exactly the same as described above. The user should refer to the manuals supplied with the Wavesaver(s) and the M232 for operating instructions.

********** NOTE **********

TO ABORT THE PROGRAM AND RETURN TO THE OPERATING SYSTEM, TYPE **"QUIT and (cr)"** AT THE COMMAND LINE.

CREATING WAVEFORMS / MODIFYING DATA:

An interesting feature about the WaveDisplay is the data received can be easily modified by any text or word processing software. Simply access the file and locate the data point that is to be modified and change it to the format desired. This in effect, enables the user to "create" waveshapes.

Waveshapes can even be created by using the FOR NEXT statement in basic, a simple triangular shaped waveform might be in the format of:-

```
  1 REM TOTAL DATA LENGTH IS EQUAL TO 512
 10 CLOSE
 20 OPEN "TRIANGLE" FOR OUTPUT AS #1   'OPEN DISKETTE FILE
 30 FOR X=1 TO 256                     'GENERATES UP SLOPE
 40 UP=1+UP
 50 PRINT#1,UP
 60 NEXT X
 70 FOR X=1 TO 256                     'GENERATES DOWN SLOPE
 80 DOWN=256-X
 90 PRINT#1,DOWN
100 NEXT X
110 END
```

IN CONCLUSION:

We have attempted to make the WaveDisplay as easy to use as possible without sacrificing speed or efficiency. As with most software, the more "hands on" time spent running the software, the more able and efficient the user will be; and again like most software, the WaveDisplay is not perfect, and we would appreciate any constructive suggestions in improving WaveDisplay.

WaveDisplay is written in a way that functional "modules" can be added to the main program to do specific types of waveform analysis, if you have a special requirement that requires a special "program", please inform us because we might include it in our upcoming WaveDisplay Utility Programs.